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Human Development with Fractional Mobility

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1. Introduction

The general concern in human development is overall change. However such changes often camouflages subtle micro-dynamics that may yield different story altogether. The partial mobility indices have been developed by Sengupta and Ghosh (2010) for this purpose.

Economists have been using mobility analysis for a long time. As argued by Quah (1993), such temporal movements may reveal patterns that are not always discernable when one considers the time movement in the aggregate. For example, the traditional analysis of per capita GDP growth veils the movement of different income groups.

The importance of positional mobility indices can be well illustrated using the following cases discussed by Dasgupta (2008). There he considered the story of two girls-one Becky in a suburban town of American Midwest and a Desta in rural Ethiopia. He argued that the lives of these two girls (who are "intrinsically very similar" Dasgupta (2008)) are so distinct from each other that they could be imagined to inhabitate different worlds. He describes Desta's world as follows:, "Desta knows well that she will be married (in all likelihood to a farmer, like her father) when she reaches eighteen and will then live on her husband's land in a neighboring village. She expects her life to be similar to that of her mother." In the terminology of mobility analysis, Desta finds herself in a perfectly immobile position. In contrast, Becky's world is depicted as a dynamic changing world. "Becky's parents also remark that her generation will be more prosperous than they." In conclusion, Dasgupta (2008) asserts, "In this article, I have used Becky's and Desta's experiences to show how it can be that the lives of essentially very similar people can become so different."

What is important here that these otherwise identical girls differ in one crucial aspect-they visualize life from different positional standpoints. The difference between the standpoints is so different that it hardly depends on the types of data we use for analysis or on the methodology we use (uni-dimensional or multi-dimensional). In speaking of positional objectivity, Sen (1993) speaks of a major ontological departure.

Sengupta and Ghosh (2010) have been able to construct positional mobility indices by developing a set of axioms that differs sharply from Shorrocks' (1978) original axioms for mobility. The positional mobility indices are termed as partial because they give only a partial picture without saying much about the whole. However these partial indices do not speak much about the magnitude of movement. For example, the probability for moving out of the lowest possible case may be 0.9 for both countries A and B indicating partial mobility

of equal magnitude. However the picture might not be so simple. For A, it means a 0.9 probability of moving to the immediate (slightly better off) group, though for B there is a 0.5 probability of moving to the more far-away cells (with 0.4 possibility of moving to the immediate cell). These magnitude differences are neglected in the partial mobility approach. Hence, we need to develop the concept of fractional mobility. This task is attempted here.

The paper is divided into five sections. Section II incorporates the new framework in the context of mobility index. It is divided into two sub-sections. In the first subsection we argue that a partial and relative measure is appropriate for analysis of human development. In the next subsection our approach is developed formally. Section III develops the new concept of fractional mobility. Section IV gives our empirical analysis of the world level performance of individual country in the context of human development according to our approach. Section V gives an example from the social field. In section VI, we conclude our study.

2. Partial mobility in human development-some methodological issues

2.1 Positive partial mobility

Aggregate (or overall) mobility indices may be quite satisfactory when we analyse certain economic phenomena (such as unemployment-where lesser mobility in the employment state is preferred) (Bhattacharya 1995). However they are clearly inadequate in the analysis of components of Human Development Index[1] (such as income, life expectancy or literacy rate).

We construct an example to substantiate our viewpoint. Consider a simple economy with three states. The mobility matrix is as follows

$$\mathbf{P}^{ex} = \begin{pmatrix} 0.8 & 0.1 & 0.1 \\ 0.2 & 0.1 & 0.7 \\ 0 & 0.8 & 0.2 \end{pmatrix}$$

A very popular mobility measure given by Shorrocks (1978) is as follows $M_D(P) = 1 - |\det(P)|^{\alpha}$ where det (P) is the determinant of P. Taking α=1, we get $M_D(P^{ex}) = 0.58$. Now what does this mean? It means that the overall mobility in the society is 0.58 that is neither very bad nor very good. Now consider the mobility experience from the point of view of the group that belonged to the lower state at initial time period. To them, there is only a 0.2 probability of moving upwards. Hence this group will view the mobility to be rather low. For those in the middle state (at the initial period), on the other hand, there is a high probability of moving upwards (0.7) and a negative mobility (that is the probability of moving downwards) of a negligible degree (0.2). For those belonging to the highest category there is only a 0.2 probability of remaining at the initial state. Thus these three groups have entirely different mobility experiences that cannot be captured by the overall mobility measure $M_D(P)$. **Our choice of this measure is only for illustrative purpose**. We could have selected any other such popular measures instead giving roughly the same result. What we

[1] Quah (1993) pioneers the use of income mobility matrix for evaluation of social purposes in his study of global inequality.

argue is that a single mobility measure cannot capture different mobility experiences that different groups face in the field of human development. We should instead move on to the **partial mobility measures** that try to capture group-specific mobility[2].

The alternative framework emphasises on the mobility from the view point of a particular section of the society. In our analysis each interval (or class) represents a particular section. Since each row corresponds to an interval at the time period *t*, mobility with respect to a row chalks out the movement of that interval over the entire time point. There will thus be (*k*-1) partial mobility indices[3] $M^i(P)$ with $i = 1,2.....k-1$. Each index summarizes the mobility from the point of view of the *i*th class. We can define $M^1(P)$ to be the **Rawlsian Ethical Mobility Index (REMI)**-viewing mobility from the most deprived category. Similarly we can define $M^{k-1}(P)$ to be the **Elitist Ethical Mobility Index (EMI)**-viewing mobility from the next to the best-endowed category[4].

In defining these mobility indices, it must be stressed that unlike the simple mobility measure here not only the degree but also the direction of change is important. Hence it is necessary to bring some ethical dimensions in mobility. In order to grasp the problem more concretely we argue that **only** movements from a **lower cell** to a **higher cell** should entail an improvement in social welfare. These partial mobility indices may be regarded as **Positive mobility indices**- they measure improvement in the social welfare.

We posit the following axioms for the positive partial mobility indices:

(A.1) **Normalization (NO):** 0≤ M(P) ≤1. This is a very mild assumption (Bhattacharya 1995). It implies that M(P) lies between zero and unity.

(A.2) **Ethical Monotonocity (EMO)**: **EMO** will imply M(P)>M(P*) if any of the two axioms are true (i) $p_{ij} \geq p^*_{ij}$ for all $i < j$ and (ii) $p_{ij} = p^*_{ij}$ for some $i < j$.

EMO indicates that for monotonicity we concentrate only the particular row (or position) whose mobility we are concerned with. Ideally then a rise in at least one of the non-diagonal p_{ij} for that row should increase the partial mobility.

(A. 3) **Ethical Immobility (EI):** $M^i(P)=0$ when the probability of staying at the i^{th} position is unity. In other words $M^i(P)=0$ when $p_{ii} = 1$.

We can posit a still milder version.

(A. 3)// **Ethical Partial Immobility (EPI):** $M^i(P)=0$ when there is zero probability for any observations (belonging to the i th row) to move to any higher cell. **EPI** ensures that $p_{i/j} \forall j > i^/ = 0$.

We can again see that if $p_{ii} = 1$, **EPI** is valid. However **EPI** is true, even when $p_{ii} \neq 1$. A logical beauty of **EPI** is that it brings us straight forward to the opposite case of perfect mobility. The relation between these two extreme cases is succinctly brought out in our case.

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[2] Aggregating individual viewpoints to get an overall picture will bring forth the traditional social choice problem that is beyond the scope of this paper.

[3] Here we are discussing only *positive mobility indices*-that is a natural extension of Shorrock's (1976, 1978) measures. The discussion of *negative mobility* is done later.

[4] In certain cases the lowest feasible category may not exist at time point *t*. In this case we may move on to the least observable category. Similarly argument may be extended for the highest feasible category *k*.

(A. 4)/ **Ethical Perfect Mobility (EPM)**: $M^i(P)=1$ when there is zero probability for any observations (belonging to the i th row) to move to any lower cell. **EPM** ensures that $p_{i/j} \forall j \leq i/ = 0$ [5]

(A. 4) **Ethical Perfect Mobility (EPM)**: $M^i(P)=1$ when there is zero probability for any observations (belonging to the i th row) to move to any lower cell. **EPM** ensures that $p_{i/j} \forall j \leq i/ = 0$ [6]

From this we can now precede to our construction of a set of partial mobility indices.

We suggest a set of positive partial mobility measures $M_{+}^{i}(P)$ as follows

$$M_{o+}{}^{i}(P) = \sum_{j=i/+1}^{k} (p_{i/j})^{\alpha} \tag{1}$$

where $\alpha \geq 1$.

The parameter α may be defined as the mobility elasticity. Given the probabilities, higher the α, higher the mobility.

2.2 Negative partial mobility

So far we considered only the issue of immobility or moving towards a better position. We may call this as an **optimistic view**. However there is another possibility that was nascent in our example- the question of deterioration or moving down to a lower cell. Thus we introduce the fact that a movement from a higher cell to a lower cell could result in a fall in welfare and label it as **negative mobility.** We regard this as a **pessimistic view**. As before there will be (*k*-1) partial negative mobility indices $M_{-}^{i}(P)$ with $i = 2\ldots\ldots k$ (in the stronger version).

For negative partial mobility the axioms are:

(A.2)// **Negative monotonocity axiom** (**NMO**): **NMO** will imply M(P)>M(P*) if the following relations are true (i) $p_{ij} \leq p_{ij}^{*}$ for all $i > j$ and (ii) $p_{ij} = p_{ij}^{*}$ for some $i > j$.

However unlike **EMO, NMO** will fail to be a subset of **MO**.

Considering immobility, we note that both **I** and **EI** are applicable even for negative mobility indices. However the axiom **EPI** has to be turned upside down in order to accommodate negative mobility indices.

(A.3)/// **Ethical Partial Negative Immobility (EPNI):** $M^i(P)=0$ when there is zero probability for any observations (belonging to the *i* th row) to move to any lower cell. **EPM** ensures that $p_{i/j} \forall j < i/ = 0$.

[5] This certainly means that **EPM** seems to imply total indifference to what happens to the various probabilities of upward mobility. An introduction of such a preference pattern will necessitate the concept of weighted partial mobility indices. We refrain from such an exercise in this paper.

[6] This certainly means that **EPM** seems to imply total indifference to what happens to the various probabilities of upward mobility. An introduction of such a preference pattern will necessitate the concept of weighted partial mobility indices. We refrain from such an exercise in this paper.

As with positive mobility, this axiom logical leads to the perfect mobility axiom from the negative side- Ethical Perfect Negative Mobility (**EPNM**).

(A.4)// **Ethical Perfect Negative Mobility (EPNM)**: $M^i(P)=1$ when there is zero probability for any observations (belonging to the i th row) to move to any higher cell. **EPNM** ensures that $p_{i/j} \forall j \geq i^{/} = 0$ [7]

We suggest a set of (negative)[8] partial mobility measures $M_{-}^{i}(P)$ as follows

$$M_{o-}{}^{i}(P) = \sum_{j=1}^{i'-1} (p_{i/j})^{\alpha} \tag{2}$$

where $\alpha \geq 1$.

We note that this measure satisfies **NO, EMO**, **I**, **EI** and **EPNI.** It is also true that the partial mobility indices $M_{o-}^{i}(P)$ satisfy **EPNM** if $\alpha = 1$. However, the result does not carry over to the generalised mobility index (6) with $\alpha > 1$.

2.3 Net mobility

Thus we have discussed both the optimistic and the pessimistic view of mobility. It is possible to interpret the positive mobility indices $M_{+}^{i}(P)$ as capturing the *pull factors*-the factors that pulls up a group to a better position. On the contrary, the negative mobility indices $M_{-}^{i}(P)$ summarize the *push factors*- the factors that push down a group to a worse position. The interest lie in assessing the net effect- whether the pull or push factors are stronger.

Now, for net mobility the axioms are:

(A.1)/// **Modified Normalization (M-NO):** $0 \leq \left| NM^{i}(P) \right| \leq 1$.

The immediate implication of this axiom is simple: $-1 \leq NM^{i}(P) \leq 1$. In essence then there are three extreme values of $NM^i(P)$- (i) the perfect immobility- $NM^i(P)=0$, (ii) the perfect positive mobility- $NM^i(P)=1$ and (iii) the perfect negative mobility- $NM^i(P)=-1$.

Thus the twin aspects of mobility are well captured within a single measure. The same should apply for Monotonicity (**MO).** The appropriate monotonicity axiom for the net measure should capture both these aspects. We now set to define it.

(A.2)/// **Modified Monotonicity (M-MO): M-MO** implies[9] $M(P)>M(P^*)$ if at least one of the relations are true:

[7] This certainly means that **EPNM** seems to imply total indifference to what happens to the various probabilities of downward mobility. An introduction of such a preference pattern will necessitate the concept of weighted partial mobility indices. We refrain from such an exercise in this paper.

[8] The adjective positive is cleared now.

(i) $p_{ij} \geq p_{ij}^{*}$ for all $i < j$ and $p_{ij} = p_{ij}^{*}$ for some $i \neq j$

(ii) $p_{ij} \leq p_{ij}^{*}$ for all $i \geq j$ and $p_{ij} = p_{ij}^{*}$ for some $i \neq j$.

Thus the partial net mobility index satisfying **M-MO** turns out to be[10]: $M^{i}(P) = f(p_{ij} \mid i < j) - g(p_{ij} \mid i \geq j)$.

We are now in a position to define net partial mobility indices[11] $NM^{i}(P)$ as follows:

$$NM^{i}(P) = M_{+}^{i}(P) - M_{-}^{i}(P) \quad (3)$$

This measure satisfies both **M-NO** and **M-MO.**

For this paper, we have considered only net *REMI* (Strong positive and weak negative version) and net *EMI* (Weak positive and strong negative version)[12]. These two ethical mobility indices are used to study global experience with human development in the recent decades.

3. Fractional mobility

A neglected issue, so far, is the magnitude of this change. A positive (negative) movement of smaller magnitude would obviously be less attractive than a movement of large magnitude. It is not only important to study whether there is a movement at all but to know how far they have moved. We provide three justifications for the importance of magnitude in partial mobility.

First, there is the logic of perceptible changes- changes that may be perceived to have some impact (positive or negative) on the destiny of the units whose mobility we are interested to study. In a dynamic society change is endemic. All types of changes are not equally significant. Suppose a researcher observes that literacy rate of a particular community have increased by only 0.01% over a period of 10 years. It is almost obvious that such an increase will be deemed insignificant in the sense of reducing the knowledge deprivation. In order to have any meaningful impact the literacy rate should improve by a minimum certain amount as prefixed by the researcher. Similar arguments may be provided for other aspects of human development.

The second argument is derived from the literature of poverty traps (Azariadis and Stachurski 2005, Dasgupta 2009). The literature essentially draws from the earlier works of Nurske and Leibenstein. They argue that there is a certain minimum threshold level (in income, productivity, skill or any such parameters) that a poor person (or society) should achieve in order to move out of the precarious condition that she is in. Unless that threshold is crossed, all the changes will be futile. The person will fall back to his initial position.

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[9] The formulation assumes weak positive and strong negative mobility. It could be appropriately modified for strong positive and weak negative mobility.

[10] This specific form follows from the form of **M-MO.** Changing it will change it.

[11] W e cannot explicitly state perfect mobility or immobility here. Since it is a net measure, the effect depends on the relative strength of the positive and negative components of the measure.

[12] See our arguments as given before.

Clearly then, to have meaningful impact, it is not enough to have mobility but mobility above some minimum threshold.

The third argument is from the vulnerability standpoint. Vulnerability theorists differentiate between static and dynamic issues of deprivation. Poverty measures deprivation from a static viewpoint. However the fact that a family in rural Ethiopia has been found to be above poverty in a certain does not signify that this family have escaped the clutches of deprivation. In any subsequent years, if the situation becomes slightly unfavourable (crop failure, political or social upheavals, food scarcity etc.) can revert the family back to the poverty level or even below that. Thus even without the threshold, unless the partial mobility rate should be above a certain minimum level to make the family less vulnerable.

The second and third issues constitute what is called *sustainable* partial mobility. A sustainable partial mobility may be defined as a mobility rate that is sufficient enough to enable the unit to maintain its new position or at least reduce the risk of reverting back to the original position.

These two issues-perception and sustainability brings in certain lumpiness within the concept of fractional mobility. This issue of lumpiness was not considered by Sengupta and Ghosh (2010). In this paper we sought to include this issue within the frame work of partial mobility developed earlier.

In short, to have meaningful discussion about the dynamics of human development, concentration should be directed towards analyzing mobility in terms of the magnitude of mobility. A movement with some specified magnitude is defined as a **fractional mobility.**

For each of the partial mobility indices defined above there will be a number of fractional mobility indices. A fractional mobility may be of different dimensions. A first-dimensional fractional mobility is the partial movement to the immediate groups or classes. Further movements are captured by higher dimensional fractional mobility. Fractional mobility can be positive, negative or net. We first consider the positive fractional mobility.

In order to derive the (positive) fractional mobility, we first introduce the axiomatic structure that is necessary for its erection. The **NO** axiom is still valid here. However the monotonocity axiom is now remodeled as **Fractional Monotonicity** (**FMO**):

(A.2)//// **Fractional Monotonocity (FMO)**: **FMO** will imply M(P)>M(P*) if any of the two axioms are true (i) $p_{ij} \geq p_{ij}^{*}$ for all $i = j + s$ and (ii) $p_{ij} = p_{ij}^{*}$ for some $i = j + s$, where the dimension of fractional mobility is s $(= i+1, i+2, \ldots\ldots, i+s)$ and $(i+s) \leq k$.

FMO indicates that for monotonicity we concentrate only the particular row and the dimension of fractional mobility we are concerned with. Ideally then a rise in at least one of the non-diagonal p_{ij} for that row within that dimension should increase the fractional mobility.

$$\text{Define: } \mathbf{T^{ex1}}= \begin{pmatrix} 0.4 & 0.4 & 0.2 \\ 0.4 & 0.3 & 0.3 \\ 0.2 & 0.3 & 0.5 \end{pmatrix}, \ \mathbf{T^{ex2}}= \begin{pmatrix} 0.5 & 0.4 & 0.1 \\ 0.5 & 0.1 & 0.4 \\ 0 & 0.5 & 0.5 \end{pmatrix}$$

In our example of T^{ex1} above it is clear that if we consider fractional mobility of one-dimension:

$$\text{(i)}\ M^1_{+1}(T^{ex1}) = M^1_{+1}(T^{ex2})$$

though if we consider fractional mobility index of dimension-2, we have:

$$\text{(ii)}\ M^1_{+2}(T^{ex1}) > M^1_{+2}(T^{ex2})$$

We now consider the next axiom of immobility. As above, though the positive fractional mobility of dimension s ($M^i_{+s}(P)$) satisfies both **I** and **EI**, they are unnecessarily strict. Rather we modify **EPI** to **FPI** for our purpose:

(A. 3)//// **Fractional Partial Immobility (FPI):** $M^i_{+s}(P)$ =0 when there is zero probability for any observations (belonging to the i th row) to move to any higher cell within the dimension s. **FPI** ensures that $p_{i'j} \forall j > i' = 0$, with $i = j + s$, where the dimension of fractional mobility is s $(= i+1, i+2, \ldots\ldots, i+s)$ and $(i+s) \le k$.

Similarly for perfect immobility we get a new modified axiom:

(A. 4)//// **Fractional Perfect Mobility (FPM)**: $M^i_{+s}(P)$ =1 when there is a unit probability for any observations (belonging to the i th row) to move to any of the higher cell within the dimension. **FPM** ensures that $p_{i'j} \forall j > i' = 1$, with $i = j + s$, where the dimension of fractional mobility is s $(= i+1, i+2, \ldots\ldots, i+s)$ and $(i+s) \le k$ [13].

We can now define positive fractional mobility of s-dimension as follows:

$$M^i_{+s}(P) = f(p_{i'j} \,|\, i = i' \ \&\ i = j) = \sum_{j=i'+1}^{i'+s} (p_{i'j})^{\alpha} \tag{4}$$

This fractional mobility index satisfy the assumptions of **NO, FMO, FPI** and **FPM** if α=1**.** As for partial mobility, this is a strict version of fractional mobility. A weaker version is possible if we consider fractional mobility of zero dimension.

We now state the axiomatic structure for the negative fractional mobility ($M^i_{-s}(P)$). **NO** is still true here. However monotonicity is now modified:

(A.2)[v] **Fractional Negative monotonocity axiom** (**FNMO**): **FNMO** will imply M(P)>M(P*) if the following relations are true (i) $p_{ij} \le p^*_{ij}$ for all $i > j$ and (ii) $p_{ij} = p^*_{ij}$ for some $i > j$ for some $i = j - s$, where the dimension of fractional mobility is s $(= i-1, i-2, \ldots\ldots, i-s)$ and $(i-s) \ge 0$.

In our example of T^{ex1} above it is clear that if we consider negative fractional mobility of one-dimension:

$$\text{(i)}\ M^3_{-1}(T^{ex1}) > M^3_{-1}(T^{ex2})$$

and if we consider fractional mobility index of dimension-2, we have:

$$\text{(ii)}\ M^3_{-2}(T^{ex1}) > M^3_{-2}(T^{ex2})$$

[13] This certainly means that **FPM** seems to imply total indifference to what happens to the various probabilities of upward mobility outside the dimension.

Similarly, we now modify both **FPI** and **FPM**.

(A.3)[v] **Fractional Partial Negative Immobility (FPNI):** $M^i(P)=0$ when there is zero probability for any observations (belonging to the *i* th row) to move to any lower cell within the dimension. **EPM** ensures that $p_{i'j}\forall j < i' = 0$ for some $i = j - s$, where the dimension of fractional mobility is $s\ (= i-1, i-2, \ldots\ldots, i-s)$ and $(i-s) \geq 0$.

As with positive mobility, this axiom logical leads to the perfect mobility axiom from the negative side- Fractional Perfect Negative Mobility (**FPNM**).

(A.4)[v] **Fractional Perfect Negative Mobility (EPNM)**: $M^i(P)=1$ when there is a unit probability for any observations (belonging to the *i* th row) to move to any of the lower cell within the dimension. **EPNM** ensures that $p_{i'j}\forall j < i' = 1$ [14] for some $i = j - s$, where the dimension of fractional mobility is $s\ (= i-1, i-2, \ldots\ldots, i-s)$ and $(i-s) \geq 0$.

We can now define positive fractional mobility of s-dimension as follows:

$$M^i_{-s}(P) = f(p_{i'j} \,|\, i = i' \ \&\ i = j) = \sum_{j=i'-1}^{i'-s} (p_{i'j})^{\alpha} \tag{5}$$

This fractional mobility index satisfy the assumptions of **NO, FNMO, FPNI** and **FPNM** if α=1**.** As for partial mobility, this is a strict version of fractional mobility. A weaker version is possible if we consider fractional mobility of zero dimensions.

As for partial mobility, this is a strict version of fractional mobility. A weaker version is possible if we consider fractional mobility of zero dimensions.

Next we consider the Net Fractional Mobility ($NM^i_s(P)$). As in the case of partial mobility, this index measures the strength of pull and push factors within the dimensions of fractional indices.

The fractional net mobility index satisfies **M-NO** but the **N-MO** should be modified. It may be restated as:

(A.2)[v] **Modified Monotonicity (M-MO): M-MO** implies[15] M(P)>M(P*) if at least one of the relations are true:

(i) $p_{ij} \geq p^*_{ij}$ for all $i < j$ and $p_{ij} = p^*_{ij}$ for some $i \neq j$ with $i = j + s$, where the dimension of fractional mobility is $s\ (= i+1, i+2, \ldots\ldots, i+s)$ and $(i+s) \leq k$

(ii) $p_{ij} \leq p^*_{ij}$ for all $i \geq j$ and $p_{ij} = p^*_{ij}$ for some $i \neq j$ for some $i = j - s$, where the dimension of fractional mobility is $s\ (= i-1, i-2, \ldots\ldots, i-s)$ and $(i-s) \geq 0$.

Thus the partial net mobility index satisfying **M-MO** turns out to be[16]: $M^i(P) = f(p_{ij} \,|\, i < j) - g(p_{ij} \,|\, i \geq j)$.

[14] This certainly means that **EPNM** seems to imply total indifference to what happens to the various probabilities of downward mobility. An introduction of such a preference pattern will necessitate the concept of weighted partial mobility indices. We refrain from such an exercise in this paper.

[15] The formulation assumes weak positive and strong negative mobility. It could be appropriately modified for strong positive and weak negative mobility.

We are now in a position to define net fractional mobility indices[17] $NM^{i}_{s_1 s_2}(P)$ as follows:

$$\mathrm{NM}^{i}_{s_1 s_2} = M^{i}_{+s_1}(P) - M^{i}_{-s_2}(P) \tag{6}$$

This measure satisfies both **M-NO** and **M-MO.** It can be both symmetric ($s_1 = s_2$) and asymmetric ($s_1 \neq s_2$)

4. Global experience of partial and fractional mobility

The measures developed above are readily applicable to the world data on human development. Such data are available from the website of United Nation Development Programme (UNDP)[18]. We have selected a time span of ten years covering three time points: 1997, 2002, 202007[19]. These points are selected only to capture the era of globalization and integration of world economy.

We have selected three dimension of human development-Education Index (EI), Gross Domestic Product Index (GDP Index) and Life Expectancy Index (LE Index) together with the Human Development Index (HDI). Our analysis is given in the Table1 to Table 4[20]. Relative mobility table is provided in the Appendix (Table A1 to Table A4). In the original UNDP figure (Human Development Report 2009) the countries were divided into four categories: Very High Human Development, High Human Development, Medium Human Development and Low Human Development. The same classification is maintained in the categorization of the mobility matrix. This would help to remove some of the ambiguity regarding the discrete classification in mobility matrix.

There are numerous debates regarding the long run performance in the global scenario. Our analysis however being partial does not give any unilateral picture. Considering partial mobility, we see a clear improvement in the partial mobility of Rawlsian class in the two separate time points regarding all the parameters of human development. However, net mobility though decreasing is still negative for these countries. As to the elitist category, there is a mix picture, while under education there is some deterioration; there is a clear improvement for GDP index and all other parameters. In short, the benefit of globalisation is reaching at a very slow rate to all the Rawlsian (poorest).

The analysis of fractional mobility reveals a more succinct picture. The fractional mobility indices are cumulative in nature. The dimension represents the number of classes the particular group has the possibility to traverse[21]. It is seen that for the Rawlsian group, probability of moving beyond the immediate class is zero. Thus though there might be some

[16] This specific form follows from the form of **M-MO.** Changing it will change it.
[17] W e cannot explicitly state perfect mobility or immobility here. Since it is a net measure, the effect depends on the relative strength of the positive and negative components of the measure.
[18] http://hdr.undp.org/en/reports/
[19] Three Human Development Reports of the year of 1999, 2004 and 2009 respectively for the mentioned time periods.
[20] The calculation of partial mobility is given in Sengupta and Ghosh (2010).
[21] The calculation is same as that of partial mobility. However here we consider only a sub-group of the classes instead of all the classes as under the partial mobility.

mobility for the Rawlsian class, it is very weak. None of the Rawlsian countries could move from "very poor" to "rich" or even the "moderate category".

HDI (Rawlsian)	Strict Positive Mobility				
	Frac. (Dim-0)	Frac. (Dim-1)	Frac. (Dim-2)	Frac. (Dim-3)	Partial
1997-2002	NA	0.15	0.15	0.15	0.15
2002-2007	NA	0.39	0.39	0.39	0.39
1997-2007	NA	0.41	0.41	0.41	0.41
HDI (Elitist)	Weak Positive Mobility				
1997-2002	1	NA	NA	NA	1
2002-2007	1	NA	NA	NA	1
1997-2007	1	NA	NA	NA	1
HDI (Rawlsian)	Weak Negative Mobility				
1997-2002	0.85	NA	NA	NA	0.85
2002-2007	0.61	NA	NA	NA	0.61
1997-2007	0.59	NA	NA	NA	0.59
HDI (Elitist)	Strict Negative Mobility				
1997-2002	NA	0	0	0	0
2002-2007	NA	0	0	0	0
1997-2007	NA	0	0	0	0
HDI (Rawlsian)	Net Mobility				
1997-2002	-0.85	-0.85	-0.85	-0.85	-0.85
2002-2007	-0.61	-0.61	-0.61	-0.61	-0.61
1997-2007	-0.59	-0.59	-0.59	-0.59	-0.59
HDI (Elitist)	Net Mobility				
1997-2002	1	1	1	1	1
2002-2007	1	1	1	1	1
1997-2007	1	1	1	1	1

Note: Frac. implies Fraction; NA implies Not Applicable, Dim implies Dimension.
Source: Authors' calculation

Table 1. Partial and Fractional Mobility for Human Development Index

Interestingly, almost all of the Rawlsian countries belong to Africa (See Table of Appendix A5). Most of these countries remain at the Rawlsian level throughout the time span. On the contrary, all the elitist countries belong to the industrialised developed countries including some non European countries (such as Japan and Australia). In short, even after the phenomenal expansion of the world economy, the polarisation is still prominent. What may be the cause of this persistence?

In this respect, we may focus on the debate on "poverty culture" recently rejuvenated by Karelis (2007). In this "controversial" book, he looks at the consequences of poverty that go well beyond the normal quantitative analysis. He argues that the "economics of Well-off can't help the poor". Remaining under sustained poverty for a long time infringes upon on the psychological domain of the poor. Poverty arises not from having something less than others but from failure from full participation in the fruits of the society (Karelis 2007). Such exclusion results in the dysfunctional personality in the individual variously termed as

apathy, the fragmented self and *akrasia*- the weakness of will or atypical preferences. It generates peculiar and "non-rational" behavior of the poor. These activities are, in general, harmful to the long –run interest of the poor. Yet these activities are undertaken for temporary "relief".

EI (Rawlsian)	Strict Positive Mobility				
	Frac. (Dim-0)	Frac. (Dim-1)	Frac. (Dim-2)	Frac. (Dim-3)	Partial
1997-02	NA	0.19	0.19	0.19	0.19
2002-2007	NA	0.43	0.43	0.43	0.43
1997-2007	NA	0.52	0.52	0.52	0.52
EI (Elitist)	Weak Positive Mobility				
1997-2002	1.00	NA	NA	NA	1.00
2002-2007	0.94	NA	NA	NA	0.94
1997-2007	0.97	NA	NA	NA	0.97
EI (Rawlsian)	Weak Negative Mobility				
1997-2002	0.81	NA	NA	NA	0.81
2002-2007	0.57	NA	NA	NA	0.57
1997-2007	0.48	NA	NA	NA	0.48
EI (Elitist)	Strict Negative Mobility				
1997-2002	NA	0	0	0	0
2002-2007	NA	0.06	0.06	0.06	0.06
1997-2007	NA	0.03	0.03	0.03	0.03
EI (Rawlsian)	Net Mobility				
1997-2002	-0.81	-0.81	-0.81	-0.81	-0.81
2002-2007	-0.57	-0.57	-0.57	-0.57	-0.57
1997-2007	-0.48	-0.48	-0.48	-0.48	-0.48
EI (Elitist)	Net Mobility				
1997-2002	1	1	1	1	1
2002-2007	0.94	0.88	0.88	0.88	0.88
1997-2007	0.97	0.94	0.94	0.94	0.94

Source: Authors' calculation

Table 2. Partial and Fractional Mobility for Education Index (EI)

Such a phenomenon may well transmit to the analysis of the countries. A poor country may find it more prudent to get short-run relief enhancing activities rather than pursuing a more sustained long-run growth. Faced by limited opportunities and very little prospect of moving out of the vicious circle of poverty in the foreseeable future, these nations undertake activities that are detrimental to their own long run interest. A sort of poverty culture develops that fasten these poor countries to the low point they are in.

LEI (Rawlsian)	Strict Positive Mobility				
	Frac. (Dim-0)	Frac. (Dim-1)	Frac. (Dim-2)	Frac. (Dim-3)	Partial
1997-2002	NA	0.08	0.08	0.08	0.08
2002-2007	NA	0.32	0.32	0.32	0.32
1997-2007	NA	0.37	0.37	0.37	0.37
LEI (Elitist)	Weak Positive Mobility				
1997-2002	1	NA	NA	NA	1
2002-2007	1	NA	NA	NA	1
1997-2007	1	NA	NA	NA	1
LEI (Rawlsian)	Weak negative Mobility				
1997-2002	0.92	0.92	0.92	0.92	0.92
2002-2007	0.68	0.68	0.68	0.68	0.68
1997-2007	0.63	0.63	0.63	0.63	0.63
LEI (Elitist)	Strict negative Mobility				
1997-2002	NA	0	0	0	0
2002-2007	NA	0	0	0	0
1997-2007	NA	0	0	0	0
LEI (Rawlsian)	Net Mobility				
1997-2002	-0.92	-0.92	-0.92	-0.92	-0.92
2002-2007	-0.68	-0.68	-0.68	-0.68	-0.68
1997-2007	-0.63	-0.63	-0.63	-0.63	-0.63
LEI (Elitist)	Net Mobility				
1997-2002	1	1	1	1	1
2002-2007	1	1	1	1	1
1997-2007	1	1	1	1	1

Source: Authors' calculation

Table 3. Partial and Fractional Mobility for Life Expectancy Index (LEI)

GDPI (Rawlsian)	Strict Positive Mobility				
	Frac (Dim-0)	Frac (Dim-1)	Frac (Dim-2)	Frac (Dim-3)	Partial
1997-2002	NA	0.19	0.19	0.21	0.21
2002-2007	NA	0.25	0.25	0.25	0.25
1997-2007	NA	0.31	0.31	0.33	0.33
GDPI (Elitist)	Weak Positive Mobility				
1997-2002	0.82	NA	NA	NA	0.82
2002-2007	1	NA	NA	NA	1
1997-2007	1	NA	NA	NA	1
GDPI (Rawlsian)	Weak Negative Mobility				
1997-2002	0.79	NA	NA	NA	0.92
2002-2007	0.75	NA	NA	NA	0.68
1997-2007	0.67	NA	NA	NA	0.63
GDPI (Elitist)	strict Negative Mobility				
1997-2002	NA	0.18	0	0	0.18
2002-2007	NA	0	0	0	0
1997-2007	NA	0	0	0	0
GDPI (Rawlsian)	Net Mobility				
1997-2002	-0.79	-0.79	-0.79	-0.79	-0.79
2002-2007	-0.75	-0.75	-0.75	-0.75	-0.75
1997-2007	-0.67	-0.67	-0.67	-0.67	-0.67
GDPI (Elitist)	Net Mobility				
1997-2002	0.82	0.64	0.64	0.64	0.64
2002-2007	1	1	1	1	1
1997-2007	1	1	1	1	1

Source: Authors' calculation

Table 4. Partial and Fractional Mobility for Gross Production Index (GDPI)

5. Social dimensions in fractional mobility

Frequently, we see in the social fields, changes that are partial. For example, in an otherwise poor tribal society, women have greater freedom than the males. This is a dilemma that the policy makers face when dealing with social phenomenon. In India, for example, the so-called "dalits" includes the tribes that are given special privilege by the constitution. They are deemed as Scheduled Tribes (ST). This section of populace is seriously impoverished (as revealed by the government data). For example, according to the literacy rate in India, is lower for the Scheduled Tribes. However, the gender ratio is higher for the ST as compared to the general population. Thus though, this section is backward in many respects, there is far less discrimination regarding the gender discrimination. In fact, in some tribal societies, matrilineal pattern exist that gives substantial preference to women. However these women are victims of upper caste people. Thus the tribal women are peculiarly placed. They are partially empowered There is thus a partial improvement-the empowerment of women within the community. A fractional movement would help us to understand the dimensions of this partial empowerment in a changing world. As these people become developed, the dominant patrilineal pattern emerges that is imminent from a deterioration gender ratio over time.

6. Conclusion

This chapter attempts to bring in the partial changes that may be different from an overall or aggregate change. A new concept of fractional mobility is developed for this purpose. The analysis is then extended to the World data covering country specific data. It reveals that even after the phenomenal expansion of the world economy, the polarisation is still prominent. A "poverty culture" is then seen to develop that dampen the recovery prospect of the poor Rawlsian economies. A social example of partial and fractional mobility is provided.

7. Appendix

(a) 1997-2002 Number of Countries	Upper end point			
	0.5	0.8	0.9	1
34	0.85	0.15	0.00	0.00
90	0.04	0.84	0.11	0.00
27	0.00	0.04	0.70	0.26
18	0.00	0.00	0.00	1.00
(b) 2002-202007 Number of Countries	0.5	0.8	0.9	1
33	0.61	0.39	0.00	0.00
82	0.00	0.72	0.28	0.00
29	0.00	0.00	0.62	0.38
25	0.00	0.00	0.00	1.00
(c) 1997-202007 Number of Countries	0.5	0.8	0.9	1
34	0.59	0.41	0.00	0.00
90	0.00	0.64	0.36	0.00
27	0.00	0.00	0.33	0.67
18	0.00	0.00	0.00	1.00

Source: Authors' calculation

Table A1. Inter countries relative HDI dynamics, 1997, 2002 and 202007 first order transition matrix, time stationary.

(a) 1997-2002 Number of Countries	Upper end point			
	0.5	0.8	0.9	1
27	0.81	0.19	0.00	0.00
54	0.02	0.76	0.22	0.00
49	0.00	0.0816	0.7347	0.1837
39	0.00	0.00	0.00	1.00
(b) 2002-202007 Number of Countries	0.5	0.8	0.9	1
23	0.57	0.43	0.00	0.00
50	0.00	0.76	0.22	0.02
48	0.00	0.00	0.79	0.21
48	0.00	0.00	0.06	0.94
(c) 1997-202007 Number of Countries	0.5	0.8	0.9	1
27	0.48	0.52	0.00	0.00
54	0.00	0.63	0.35	0.02
49	0.00	0.00	0.65	0.35
39	0.00	0.00	0.03	0.97

Source: Authors' calculation

Table A2. Inter countries relative Education Index dynamics, 1997, 2002 and 202007 first order transition matrix, time stationary.

(a) 1997-2002 Number of Countries	Upper end point			
	0.5	0.8	0.9	1
38	0.92	0.08	0.00	0.00
88	0.03	0.82	0.15	0.00
42	0.00	0.2007	0.86	0.2007
1	0.00	0.00	0.00	1.00
(b) 2002-202007 Number of Countries	0.5	0.8	0.9	1
38	0.68	0.32	0.00	0.00
78	0.00	0.78	0.22	0.00
49	0.00	0.10	0.43	0.47
4	0.00	0.00	0.00	1.00
(c) 1997-202007 Number of Countries	0.5	0.8	0.9	1
38	0.63	0.37	0.00	0.00
88	0.023	0.705	0.261	0.011
42	0.000	0.048	0.357	0.595
1	0.00	0.00	0.00	1.00

Source: Authors' calculation

Table A3. Inter countries relative Life Expectancy Index dynamics, 1997, 2002 and 202007 first order transition matrix, time stationary.

(a) 1997-2002 Number of Countries	Upper end point			
	0.5	0.8	0.9	1
52	0.79	0.19	0.00	0.02
81	0.04	0.86	0.10	0.00
25	0.00	0.04	0.48	0.48
11	0.00	0.00	0.18	0.82
(b) 2002-202007 Number of Countries	0.5	0.8	0.9	1
44	0.75	0.25	0.00	0.00
81	0.05	0.72	0.22	0.01
22	0.00	0.00	0.23	0.77
22	0.00	0.00	0.00	1.00
(c) 1997-2007 Number of Countries	0.5	0.8	0.9	1
52	0.67	0.31	0.00	0.02
81	0.025	0.654	0.259	0.062
25	0.00	0.00	0.08	0.92
11	0.00	0.00	0.00	1.00

Source: Authors' calculation

Table A4. Inter countries relative Gross Domestic Production Index dynamics, 1997, 2002 and 202007 first order transition matrix, time stationary.

Rawlsian Countries	Elitist Countries
Niger, Sierra Leone, Central African Republic, Mali, Burkina Faso, Congo (Democratic Republic of the), Chad, Burundi, Guinea-Bissau, Mozambique, Ethiopia, Guinea, Rwanda, Senegal, Eritrea, Zambia, Côte d'Ivoire, Benin, Malawi,Togo	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Iceland, Japan, Luxembourg, Netherlands, New Zealand, Norway, Sweeden, Switzerland, United Kingdom, United States

Table A5. Consistent Rawlsian and Elitist countries over the three time periods

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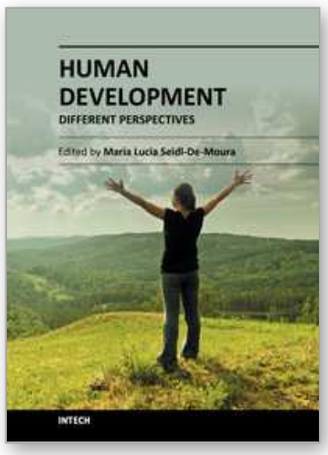

Human Development - Different Perspectives

Edited by Dr. Maria Lucia Seidl-De-Moura

ISBN 978-953-51-0610-4
Hard cover, 110 pages
Publisher InTech
Published online 16, May, 2012
Published in print edition May, 2012

Human development has different meanings depending on the area we focus on. To the psychologists it is the ontogenetic process of individual development. It considers systematic psychological changes that occur in human beings over the course of their life span. To sociologists and economists, among others, the main consideration is the macro-level of countries or regions and their development conditions related to human needs. Our book has two parts. The first one is entitled "Development in the ontogenesis" and it consists of three chapters whilst the second is "Human development: contextual factors", also including 3 chapters. Together, the two parts give the readers a panoramic view of very complex subjects and complement each other. Researchers of ontogenetic development cannot ignore that contextual factors are the basis of this process. On the other hand, social scientists worried about the macro variables need to remember that they are dealing with people, who are affected one way or another by those variables and whose development is the product of biology and culture.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Atanu Sengupta and Abhijit Ghosh (2012). Human Development with Fractional Mobility, Human Development - Different Perspectives, Dr. Maria Lucia Seidl-De-Moura (Ed.), ISBN: 978-953-51-0610-4, InTech, Available from: http://www.intechopen.com/books/human-development-different-perspectives/development-dynamics-from-different-positions-a-study-in-the-human-development

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